(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 671 800 A1**

(12) **EUROPEAN PATENT APPLICATION published in accordance with Art. 158(3) EPC**

(21) Application number: **94927799.0**

(51) Int. Cl.[6]: **H02K 3/18**

(22) Date of filing: **28.09.94**

(86) International application number:
PCT/JP94/01610

(87) International publication number:
WO 95/09474 (06.04.95 95/15)

(30) Priority: **29.09.93 JP 242592/93**
24.12.93 JP 328645/93

(43) Date of publication of application:
13.09.95 Bulletin 95/37

(84) Designated Contracting States:
DE FR GB IT

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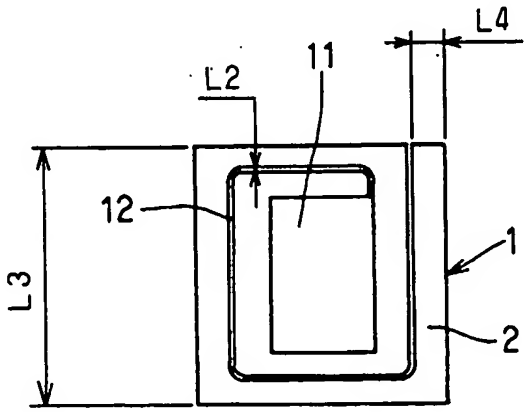
(54) FIELD COIL FOR MOTOR.

(57) A field coil for a motor such that the labor and time required for winding the field coil around the pole core of the stator are eliminated and the space factor is improved. An opening (11) for passing the pole core (4) incorporated in the stator (3) is formed in a conductor (1). A spiral slit (12) which is made through the conductor (1) in the thickness direction ad connects the outer periphery of the conductor (1) to the opening (11) is formed. An insulator is provided in the slit (12) as necessary.

FIG. 1



EP 0 671 800 A1

TECHNICAL FIELD

This invention is related to a field coil for motors used, for instance, for starter motors.

BACKGROUND ART

Conventionally in the motor used for starters, the space factor of the field coil in the motor was increased as an effective method to downsize the motor.

In this case, a straight planar conductor covered with an insulation film having a sufficient insulation resistance has been used generally. If this straight planar conductor is applied to a field device having four magnetic poles as shown in Fig. 6, the straight planar conductor 20 is wound around a pole core 4 of a stator 3 as shown in Fig. 5, one end 20a of the straight planar conductor 20 is connected to the straight planar conductor wound on the neighboring magnetic pole via a connector bar 8, and the other end 20b is connected to a brush 5.

In the abovementioned conventional straight planar conductor 20, the straight planar conductor is wound on the pole core 4, so the insulation films on the surfaces of the straight planar conductors 20 contact creating a double layer insulation films. This requires the wire winding work. Further, although the withstanding voltage between the straight planar conductors is lower than between the stator 3 and the straight planar conductor 20, the insulation films become excessive between the straight planar conductors. Thus, the problem of decrease in the space factor of the field coil occurs.

This invention undertakes the above problems, and aims at providing a field coil that can greatly increase the space factor without requiring winding on a pole core.

DISCLOSURE OF THE INVENTION

To solve the above problem, this invention uses a field coil characterized by an opening formed by elimination of a part of a conductor and passing therethrough a pole core of a stator that provides a magnetic path, and by a spiral slit passing the conductor in the thickness direction and formed around the periphery of the opening.

According to this invention, by arranging the opening formed by eliminating a part of the conductor and the spiral slit, the required field coil for winding can be easily obtained, and the field coil need not be wound around the pole core. As the width of the slit can be set smaller, it need not be made to be excessively wide, and the space factor of the field coil can be greatly improved.

Further, the insulation material is provided in a part of the spiral slit or along the entire slit length. Therefore, even if the slit width is decreased to a minimum, the insulation material in the slit prevents short-circuiting between the coils and the space factor is improved further.

Still furthermore, provided that a plurality of field coils are formed integrally by forming the opening and the spiral slit in plural numbers for one conductor, the field coils for a plurality of magnetic poles can be formed at once. As a result, the space for the connector bar which connects the field coils is not required, and the space factor of the field coil can be improved by that amount. Furthermore, the number of required parts can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a top plan view of a field coil showing an embodiment of this invention;

Figure 2 is a side view showing the state with the coil in Figure 1 mounted on a field device;

Figure 3 is a top plan view of a field coil showing another embodiment of this invention;

Figure 4 is a side view showing the state with the coil in Figure 3 mounted on the field device;

Figure 5 is a top plan view of a conventional field coil;

Figure 6 is a side view showing the state with the conventional coil in Figure 5 mounted on the field device; and

Figure 7 is a side view partly in cross section of a speed reduction gear type starter incorporating the embodiment of this invention.

BEST MODE FOR CARRYING OUT THE INVENTION

This invention will be explained with reference to the embodiments shown in the drawings.

Fig. 1 shows a top view of the field coil 2 before being installed on a motor's stator. The field coil 2 is made of a conductor 1 (e.g., copper plate). In the center of this conductor 1 is a rectangular opening 11 through which a pole core that functions as a magnetic pole in the stator is passed through, although not shown in Fig. 1. Numeral 12 designates a spiral slit which is machined to cover the outer periphery of the opening 11 of the conductor 1 and which, passing through in the thickness direction, connects the outer circumference of the conductor 1 and the opening 11. Because the conductor 1 is divided by this slit 12, the field coil 2 is formed to have the line width L4. The slit 12 can be machined with mechanical machining, electrical discharge machining, laser beam machining or hydraulic pressure machining.

After machining the slit 12, as shown in Fig. 2, the field coil 2 is bent and formed along the arc shape of an inner circumferential surface 31 of the stator 3 that is a part of the field device, and then epoxy resin is applied to insulate the outer surface of the field coil 2. Then, the field coil 2 is placed on an inner surface 31 of the stator 3 and is engaged with a head 41 of the pole core 4. The base of the field coil 2 is sandwiched and fixed by a pole claw 42.

At this time, the width L2 of the slit 12 is so set that the field coil wires do not contact one another and short-circuit, after assembling the field coil 2 onto the stator 3. The arc length L1 of the field coil 2 is set so that the length is equivalent to one pole core length, and the horizontal length L3 is set to be in approximately the axial length of the armature core of the motor which is not shown.

As methods to insulate the field coil 2, insulation material to insulate the coil wires can be inserted into the slit 12 (e.g., insertion of insulation paper, or application or injection of resin), or the insulation material (e.g., powder) can be applied on the entire surface including the slit 12 of conductor 1, after the slit 12 is machined in the conductor 1. In this case, the width L2 of the slit 12 may be determined by the insulation material to be inserted into the slit.

With the above procedure, as the field coil 2 with the required number of windings can easily be obtained by machining and forming the slit 12 on the conductor 1 and the width L2 of the slit 12 in which the insulation material is laid can be arbitrarily set according to the withstanding voltage between the coil wires of the field coil, the insulation material will not become excessive and the space factor of the field coil 2 will be greatly improved. Furthermore, the wire width L4 of the field coil 2 can be arbitrarily set by the slit 12 so that the conductive current density does not become extremely high.

Furthermore, in the conventional straight planar conductor 20 having the insulation film on the outer circumference as shown in Figs. 5 and 6, the film may peel off and may cause a short-circuiting when wound on the pole core 4 of the stator 3. In this invention, however, the field coil 2 does not require winding, so the insulation material will not be separated during winding.

As is clear from the above explanation, by arranging the opening formed by eliminating the conductor and the spiral slit, the field coil with required winding can be obtained easily and the space factor of the field coil can be improved greatly. Thus, the effect in manufacturing and performance are remarkable for use in motors having relatively few windings and with a large conductor cross section area such as a motor for starter requiring a large rated output in a short-time. To further downsize the starter, this invention provides a great effect in reducing the size of the motor by incorporating the speed reduction gear mechanism as shown in Fig. 7.

Another embodiment of this invention will be explained next. Fig. 3 shows the field coil 2 for two magnetic poles formed with one conductor 1 and formed by arranging one set of slits 12.

Fig. 4 shows the example of using the field coil 2 shown in Fig. 3 for the stator 3 of the field device having four magnetic poles. Two conductors 1 are laid out.

In other words, two conductors 1 are each laid out in the inner surface 31 of the stator 3, engaged with the head of the pole core 4 and fixed to the inner surface 31 by sandwiching the base of the conductor 1 with the pole claw 42. One end 2a of the two field coils 2 formed by one conductor is connected to the stator 3, and the other end 2b of the same is connected to a brush 5. One end of the two field coils 2 formed by the other conductor is connected to a lead wire 7, and the other end of the same is connected to the brush 6.

Therefore, by employing the structure shown in Figs. 3 and 4, the field coil 2 for the two magnetic poles can be formed by one conductor 1 and the connector bar 8 connecting the field coils 2 as shown in Fig. 6 is no longer required. This allows space to be used effectively, and the space factor of the field coil 2 laid out in the stator 3 which forms a part of the field device can be improved further. Furthermore, the motors using this field coil 2 can be remarkably downsized.

In the above embodiments, although each piece of the conductor 1 is laid out in the inner surface direction of the stator 3, multiple pieces of conductor 1 can be overlaid in the inner surface direction of the stator 3.

Furthermore, in this invention, although field coil 2 is formed to follow the arc shape of the inner surface 31 of the stator 3 after slit machining, the slit machining can be performed after the formation. In this case, the slit width L2 can be made narrower and the space factor can be improved greatly.

INDUSTRIAL APPLICABILITY

As described above, the field coil for motors according to the present invention does not require winding the field coil around the magnetic pole and, in particular, can be used as the field device disposed in the starter.

Claims

1. A field coil for motors comprising:
   a conductor formed with an opening and a spiral slit;
   said opening being formed by eliminating a part of said conductor for passing therethrough a pole core of a stator forming a magnetic path; and
   said spiral slit being formed to pass through said conductor in a thickness direction along a circumference of said opening.

2. A field coil for motors as set forth in claim 1, wherein an insulation material is provided in said spiral slit partly or along an entire length.

3. A field coil for motors as set forth in claim 1, wherein said opening and said spiral slit are formed at a plurality of locations in said conductor so that a plurality of field coils are formed integrally.

FIG. 1

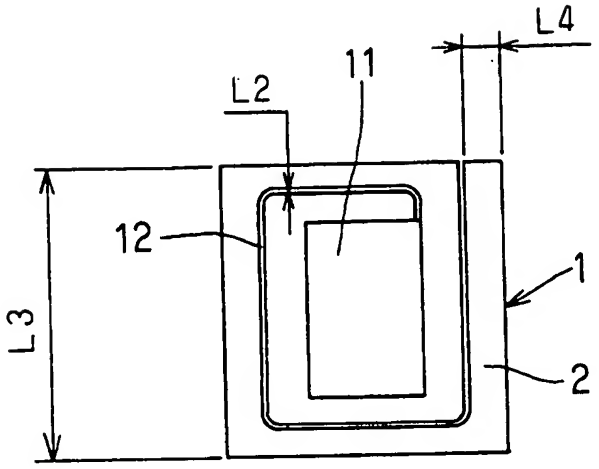


FIG. 2

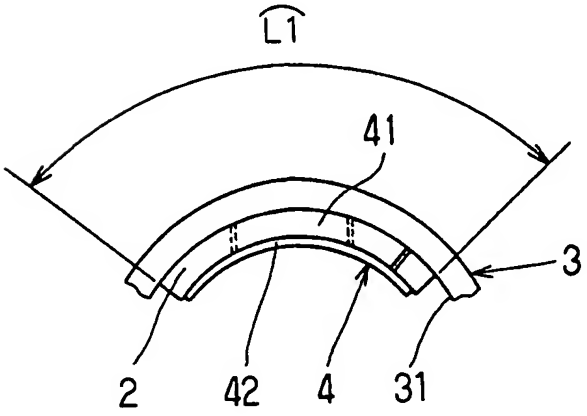


FIG. 3

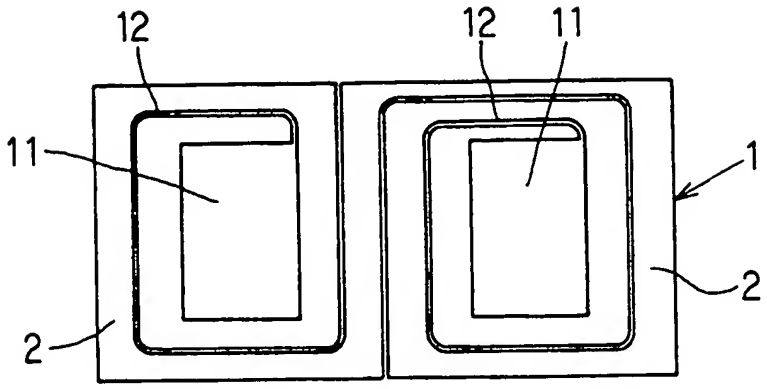


FIG. 4

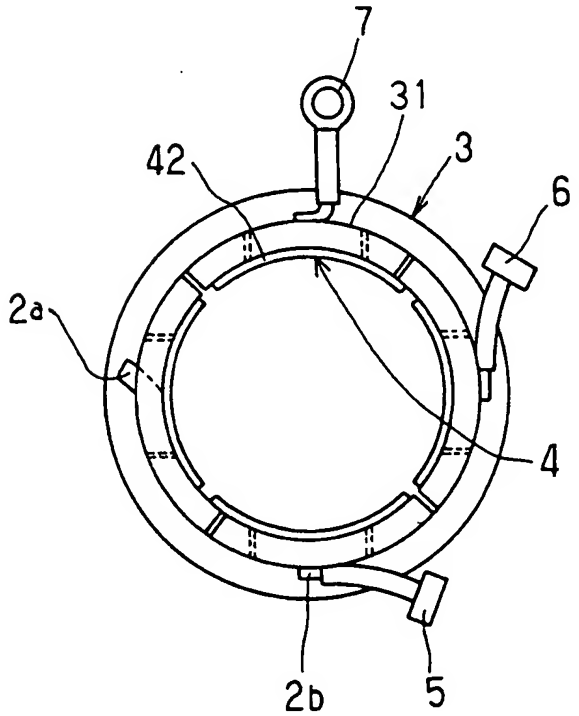


FIG. 5 PRIOR ART

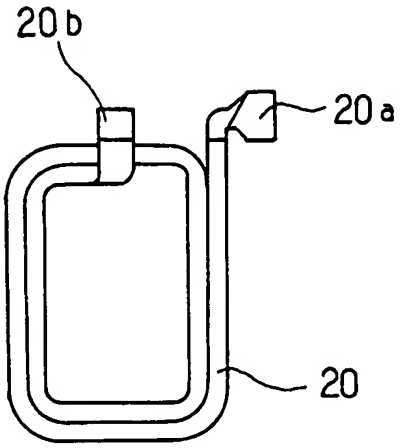
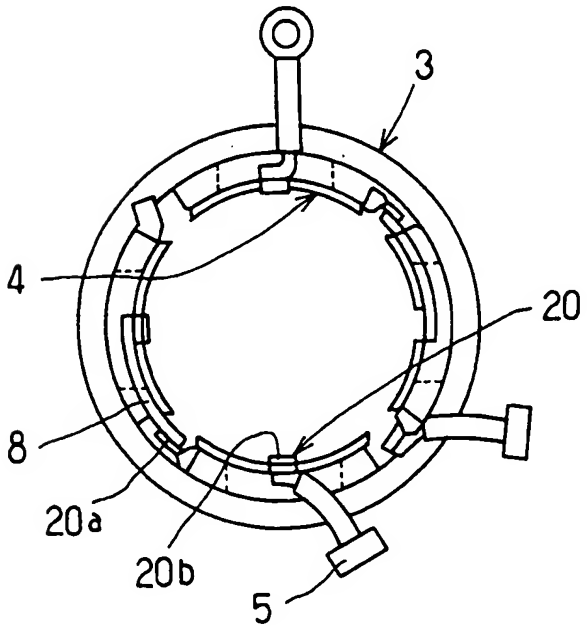


FIG. 6 PRIOR ART



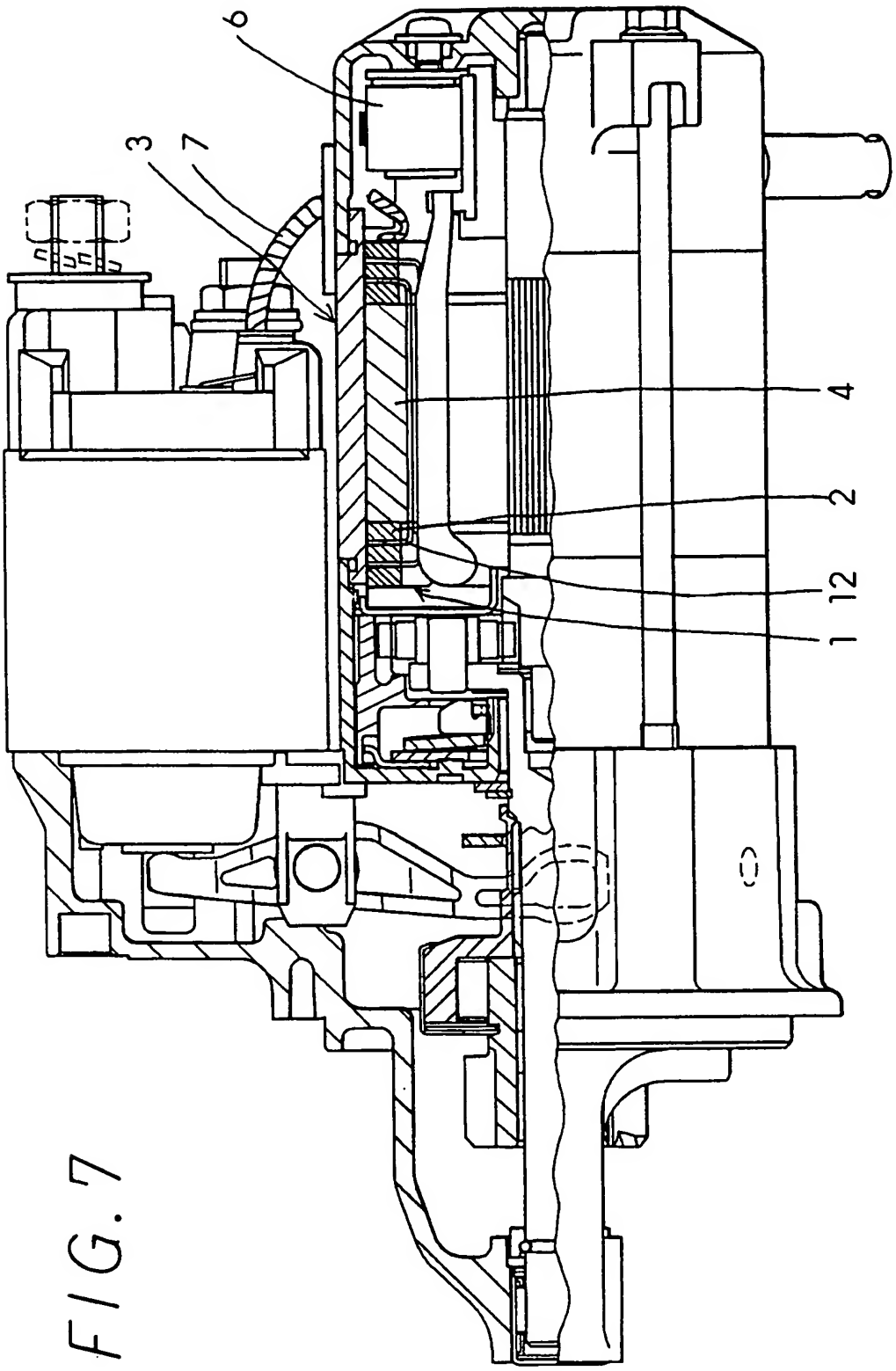


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP94/01610

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl^6 H02K3/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl^5 H02K3/04, H02K3/18, H02K3/26, H02K15/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1926 - 1994
Kokai Jitsuyo Shinan Koho 1971 - 1994

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, Y1, 6-3549 (Hitachi, Ltd.), April 2, 1931 (02. 04. 31), Figs. 1 to 2, (Family: none)	1-3
Y	JP, B2, 4-1573 (Fanuc Ltd.), January 13, 1992 (13. 01. 92), Figs. 1 to 4 & JP, A, 62-53146	1-3

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
November 30, 1994 (30. 11. 94)	December 20, 1994 (20. 12. 94)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)